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An Enhanced Bandwidth Optimization in Un-reliable Network Using Efficient Bandwidth Utilization based Scheduling Algorithm

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Article Info	ABSTRACT
	Nowadays, bandwidth utilization is a very challenging task for Subscriber Stations (SS) to predict a large amount of data. The existing techniques allow the SS to maintain the occupied bandwidth via risk of failure which does not satisfy the quality of services (QoS) needs. Another challenge is the resource handling with QoS. In Web technology life, there is only few research focused on tackling the resource handling issues with different techniques. Current methods do not consider the data interchange during route switching. To offer the best solution of above problems, An Efficient Bandwidth Utilization based Scheduling (EBS) Algorithm is designed to maintain proper bandwidth utilization in a real-time application. The EBS algorithm predicts the amount of bandwidth which should be requested according to backlogged traffic data. It's also considering the data rate divergence between a packet received and transmissions in a queue to improve the bandwidth. The main objective of proposed design is to permits other complementary station (CS) and SSs to bring out the unutilized bandwidth by the availability of SS transmission. The unutilized bandwidth is not possible to get regularly. The proposed method is more flexible to apply in real time and research-oriented applications. The methods enhance the bandwidth utilization during maintenance of the same QoS guaranteed network services. A proposed method avoids the current bandwidth reservation collapse at the time of the same QoS guaranteed services. The techniques permit SSs to find out the portion of un-utilized bandwidth accurately. Based on Experimental evaluations, proposed algorithm reduces 21.26 PLR (Packet Loses Ratio), 3.25 AD (Average Delay), and improves 8.65 BU (Bandwidth Utilization) and 51.2% (Throughput) compared than existing methods.

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1. INTRODUCTION

Bandwidth utilization is a vital feature to enhance the network performance. Bandwidth can be utilized in file transmission and network connections. Though transmitting the files or some document in the network out of the bandwidth, the data will be the loss. The greater part of the networks fails to guess the bandwidth accessibility exactly. Bandwidth reservation can be a critical task to enhance the system resources utilization. These kinds of frameworks will provide more inconsistency of remote channel condition complication for bandwidth estimation.

The existing systems have another issues is the resource handling with QoS. In IP world, there are a few suggestions to resource handling issues. There are a few methodologies giving different schemes to deal with QoS issues. Switching means that a constant bandwidth is allocated from the total bandwidth of the transmission medium and the whole allocated bandwidth is used for data interchange for the time. The bandwidth allocation is taking place. Regularly, this type of bandwidth usage is link oriented and needs the exchange to include several stages containing link establishment, data exchange and link finishing. It does not allocate constant bandwidth. Instead in routing, the data is transported in packages that are delivered through the network by searching for the right directions in network nodes. Consequently, routing is viewed as connectionless and it doesn't need the information exchange stages. However, its required switching.

Li et al. [1] introduced effective cache-based motion compensation architecture for HEVC (High-Efficiency Video Coding) decoder framework limited the memory data transfer capacity. Four-way parallel cache architecture explained and reduced memory bandwidth and power consumption. Yaofang Li et al. [2] described a Software-defined Networking (SDN) is an efficient technology to manage network utilization. An optimization model and heuristic service routing algorithm was designed to reduce system cost and the variance of bandwidth consumption. Jang-Ping Sheu et al. [3] discussed a multicast routing algorithm for SDN with fragment routing to serve the bandwidth requirement of a multicast routing request. The algorithm considered the balance of traffic load for network asset of connection link bandwidth and node flow entries to reduce the network overhead cost. Hui Yang et al. [4] focused a software-defined clustered-optical access networking (SD-COAN) architecture for datacenter services in pervasive datacenter optical interconnection. The SD-COAN upgraded the responsiveness to the dynamic end-to-end datacenter server requests and improve optical access network comprehensively.

Rani et al. [5] described a polynomial time algorithm in Wavelength Division Multiplexing-Passive Optical Networking (WDM-PON) to calculate disjoints of an optical network. It decreased the count of disjoints that happens in network by isolating Optical Network Units (ONU) into a few virtual point-to-point connections. Elnaka et al. [6] described a Fair and Delay Adaptive Scheduler (FDAS) method for hybrid schedule to beat fairness of allotment issues. It reduces the quantity of packets that damage their deadlines for transmission. Wang et al. [7] designed a mathematical model and a DBWA (dynamic bandwidth and wavelength allocation) method for transmission scheduling in WA-PON (wavelength-agile passive optical network). WA-PON acquires penalties regarding delay and power consumption. Fazio et al. [8] developed a pattern prediction method which worked based on a distributed set of Markov chains, to deal with passive reservations and a statistical bandwidth management algorithm for decreasing bandwidth wastage. Inoue et al. [9] introduced a memory optimization method to improve the processors with constrained memory bandwidth and diminishing the memory-bandwidth necessity. Lin et al. [10] implemented a cloud gaming system to decrease network transmission by compressing graphics information and caching information on the server and the user.

Kim et al. [11] expressed a dynamic bandwidth investigation technique that produced real-world dynamic bandwidth durations utilized closed loop traffic signal data. Shi et al. [12] explained the effectiveness of onboard resource usage in beam-hopping client downlinks; designed two joint power and timeslot allocation methods for smart gateway systems. Fan et al. [13] investigated the joint transmit power and bandwidth allocation problem for a cognitive radio framework in underlay mode. A robust optimization issue focused on maximizing the capacity of a second client while constraining the worst probability of interference outage. Sakib et al. [14] introduced a PCM-DSSS (Pulse Code Modulation-Direct succession Spread Spectrum) technique for sample by sample encryption strategy. It improved the possibility of SNR (signal to noise ratio) & decreasing the probability of bit error. In [15] examined the optimal allocation of the restricted resources, power and bandwidth in different hubs. The optimization issues are non-convex, developed an iterative linearization-based method to solve non-convex, joint power and bandwidth allocation (JPBA) problems.

Amendola et al. [16] explained an approach for the optimal tunable-complexity bandwidth manager (TCBM) for the QoS live migration of Virtual Machines (VMs). In [17] discussed a heterogeneous remote system for one or more service providers (SPs). Every SP worked in both large and small scale for offering two types of clients: mobile and fixed. Sun et al. [18] expressed a structure of the resonant output frequency gyroscope to establish decoupling frame. Al Hasrouty et al. [19] investigated the effect of utilizing Video Coding and Software Defined Networking methods in video conferencing. It decreases the bandwidth consumption in video conferencing. Wang et al. [20] developed a Hybrid Cloud Radio Access Network (H-CRAN) to reduce the power consumption and transportation of bandwidth consumption. In [23] discussed the privacy-preserving methods was vulnerable to Sybil attacks, whereby a malicious user can act as to be multiple (other) vehicles. It ensured the authenticity of the messages propagated in VANET; a straight-forward process is utilized public keys authorized by a certification authority (CA) to sign the messages. Fadli Sirait [24] developed an Ethernet over SDH (synchronous digital hierarchy) and MPLS-TP

(Multiprotocol Label Switching - Transport Profile) with ring security to predictable network failure and computed performance of network. Aman et al [25] integrated context transport and multicast quick reroute, and developed this integration to the standard network mobility management. Hashim et al. [26] discussed quantitative analysis and it computed Proxy Mobile Internet Protocol Version 6 (PMIPv6) multicast speedy reroute operations for data traffic.

To overcome these issues, the proposed techniques is designed an effective Bandwidth optimization, for utilizing the un-utilized bandwidth on same QoS services without getting an un-necessary delay. The main concept of proposed design is to permits other complementary station (CS). SSs are utilizing the un-utilized bandwidth left by the current transmitting SS. The un-utilized bandwidth is not supposed to occur regularly delay. The proposed method is used real time applications, which have more flexibility to avoid delay & utilize the un-utilized bandwidth. It is different from the bandwidth adjustment in which adjusted bandwidth is enforced as early as in the upcoming frame. Moreover, the un-utilized bandwidth is likely to be released temporarily, and the existing bandwidth reservation does not change. Hence, proposed scheme improves the overall throughput while providing the same QoS guaranteed services. The paper contribution is followed as:
a. To enhance the bandwidth utilization during maintenance of the same QoS guaranteed services.
b. To avoid the current bandwidth reservation collapse at the time of the same QoS guaranteed services.
c. To improve the bandwidth utilization by utilization the un-utilized bandwidth.
d. Reduce the packet loss, delay and bandwidth utilization of proposed system compare than existing methods

The rest of paper is organization is following as: Section 2 expresses the related work which expresses the closest technology of proposed methodology. Section 3 introduces the proposed methodology, design, implementations steps with proposed algorithms. Section 4 discusses implemented result and comparison analysis. Section 5 concludes overall work with future outcomes.

2. PROPOSED METHOD

The section explained the system architecture with proposed techniques and algorithm details. The proposed system implementation process step by step details with design architecture is explained in Figure 1. The objective of the proposed system is to enhance the bandwidth utilization during maintenance of the same QoS guaranteed services and improve the bandwidth utilization by utilization the un-utilized bandwidth. Proposed Efficient Bandwidth Utilization based Scheduling algorithm works to predicts the amount of bandwidth which should be requested according to backlogged traffic data, improve the throughput, and reduce the packet loss, delay and bandwidth utilization.

2.1. Implementation Pre-processing Steps
2.1.1. Network Construction
The network construction is designed topologically to transmit the data. The networks have peer information and connection details. Peers are interrelated and every peer can data directly transmit to another peer. Subscriber server maintains the peer address, port specification and peer status.

2.1.2. Packet Creation
In Packet creation process, the data is divided into N number of packet with the maximum length of Characters. The data is splited into packet-packet randomly based on the network speed. To improve the efficiency of packet distribution, proposed techniques is used effective data transmission. It does not only care the packet distribution but it also work to avoid the delay and packet overlapping problem.

2.1.3. Data Distribution
The data distribution process distributes the data among peers. Generally, data distribution happens between source & destination peer. Proposed techniques help to source for choosing best path to transmit the data to destination with minimal time & cost. Proposed method also works to maintain strong and effective privacy during data distribution. The shortest path identification is done based on calculation of unutilized bandwidth and communicated files in packet-packet.
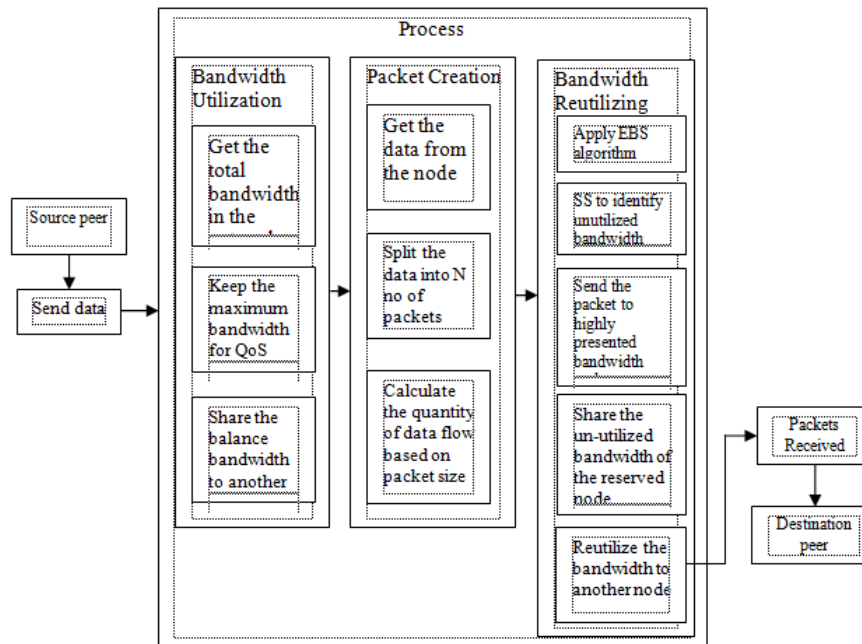
Figure 1. Workflow Diagram for Efficient Bandwidth Utilization based Scheduling Algorithm

An efficient bandwidth utilization based scheduling mechanism is designed. The quantity of the reserved resource dynamically changes, and it depends on the real quantity of active connections. In hybrid networks, dynamic bandwidth reservation is expressed for evaluation. The performance and efficiency of the hybrid network are calculated with proposed efficient methodologies. It offers guarantee of optimum reservation and utilization of bandwidth while decreasing signal blocking probability and price. In mesh mode, the system throughput is enhanced by utilization of simultaneous transmission. All segments of the unutilized bandwidth in proposed methodology, TS (Transmission Subscriber) with un-utilized bandwidth broadcasts just a stuff byte rate and a discharge message whose details are given in Figure 2. The stuff-byte rate is utilized to notify the BS that there is no more information originating from the TS.
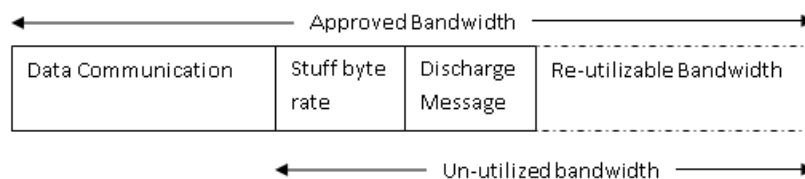

Figure 2: Discharge Messages the Unutilized Bandwidth

2.1.5. Bandwidth Reutilizing

In the frame, the un-utilized bandwidth and corresponding TS is reutilizing in the complementary station (CS). It waits for possible opportunities. BS scheduled by the CS information and it is resided into a list called Complementary List (CL). The mapping co-relation of each pre-allotted match C and TS is exhibited in CL. Demonstrated in Figure 3; every CS is mapped to at least single TS. The CL is broadcasted by the uplink map. In frontage of CL, the Transmit link ID is connected for the backward compatibility. Furthermore, stuff byte rate is broadcasted followed by the Transmit link ID to differentiate the CL from another transmitted downlink broadcast times. Bandwidth adjustment is different from the QoS guaranteed services is enforced by the adjusted bandwidth. Furthermore, temporarily released by un-utilized bandwidth (i.e., only in the current frame)) and does not change the existing bandwidth reservation. Consequently, proposed methodology enhanced the overall throughput while the same QoS guaranteed services are offered.
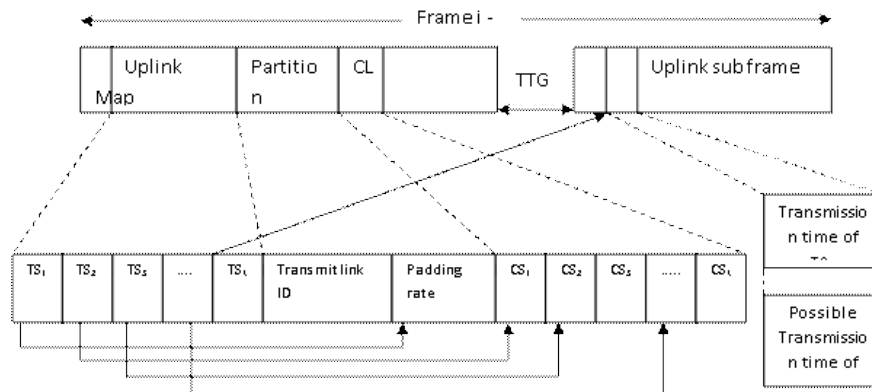
Figure 3: The Mapping Relative among CSs and TSs

2.2. An Efficient Bandwidth Utilization based Scheduling Algorithm

An Efficient Bandwidth Utilization based Scheduling Algorithm is designed for proper bandwidth utilization for real-time application services. The method predicts the volume of bandwidth to be requested based on the information of the backlogged amount of traffic in the queue and the rate mismatch between packet arrival and service rate to enhance the bandwidth utilization. The technique works to improve the performance by predicting the traffic coming in the future. The scheme can allow SSs to accurately identify the portion of un-utilized bandwidth and provides a method to utilize the un-utilized bandwidth. Proposed technique improves the utilization of bandwidth while keeping the same QoS guaranteed services without delay. The method allows the SS to indicate the extra bandwidth required for a connection. Thus, the amount of reserved bandwidth can be only increased via incremental BRs. On the other hand, the SS specifies the current state of the queue for the particular connection via an aggregate request. The BS resets its perception of that service's needs upon receiving the request. Consequently, the reserved bandwidth may be decreased.

The network is constructed between peers and subscriber station (SS). The data transmission will be done between selected source peer and destination peer. Source peer can select any one of the file to send destination; then re-request (RREQ) sent to destination peer. The destination peer accepts the RREQ and receives the transmitted file from source peer. Hence, the data is splited into some packets based on the size. Proposed EBS algorithm is applied to identify the portion of un-utilized bandwidth. The shortest path is calculated in unutilized bandwidth and packets are received by subscriber station. Bandwidth re-utilization details is sent to a destination peer; if the peer accepts the re-utilization data will be received by destination peer and calculated packet loss rate, average delay, throughput and bandwidth utilization. In every application of packet mean data rate is randomly selected. The mean packet size is created from 512 to 1024 bytes. Therefore, the mean packet arrive rate is calculated based on the equivalent mean packet size. Every packet size is measured as Poisson distribution, and packet arrival rate is measured as an exponential distribution. It influences the performance of bandwidth reutilization. The pseudo code of proposed algorithm is explained below in details:

Input   : Any types of Input Data;
Output   : Display the optimize Packet Loss Rate (PLR), Average Delay (AD), Throughput and Bandwidth Utilization (BU).
Procedure   : Start
                Arrange the peers (p) and subscriber station (SS);
                Browse any data file to send;
                Select destination peer;
                Re-request (RREQ) the destination file;
                If RREQ accept
                Split the data into N no of packet;
                Send the packet to subscriber station (SS);
                Else
                Fail to accept Re-request (RREQ);
                Apply EBS algorithm;
                Shortest path identification;
                Measure un-utilized bandwidth by using SSs;

Apply Bandwidth re-utilization;
If re-utilization accept
Transmit data to destination peer;
Calculate & visualize PLR, AD, throughput and BU;
Else
Fail to accept Re-request Bandwidth Reutilization;

3. RESULTS AND ANALYSIS
3.1. Programming Environment

The proposed techniques are deployed with Intel i6 Core processor, with 16 GB RAM, 60 GB Memory with Windows7 Ultimate operating systems. The algorithm is implemented in Java programming environment by using NetBeans 8.0.2, MYSQL database 5.5, Java Remote Access Library with 50 peers in centralized server environment.

3.2. Implemented Result

The proposed algorithm is evaluated on different kinds of parameters to measure the efficiency of techniques. The proposed is technique highly dedicated to offers effective data transmission with minimal resource optimization on equal QOS guarantee services. The proposed algorithm is evaluated with following parameters namely Packet Loose Rate, Average Delay, Throughput and Bandwidth Utilizations.

3.2.1. Packet Loss Rate

The packet loss ratio indicates, how proposed system offering effective data transmissions. The Packet Loss Rate (PLR) is the ratio of the number of packets dropped to the number of data packets sent. The PLR is calculated in Equation (1).

$$PLR = \frac{Total\ Packets\ Dropped}{Total\ Packets\ Send} \tag{1}$$

3.2.2. Average Delay

The average delay is defined as the time difference between the packets received time & packet sent time. It displays data transmission delay between source and destinations. The delay is measured in Equation (2).

$$Average\ Delay = \frac{Pkt\ Recvd\ Time - Pkt\ Sent\ Time}{time} \tag{2}$$

3.2.3. Throughput

Throughput is the average ratio of success delivered content or message to the destination. The throughput indicates efficiency of proposed methods. The average throughput is calculated in Equation (3).

$$Throughput = \frac{\sum_{0}^{n} Pkts\ Received\ (n)*Pkt\ Size}{1000} \tag{3}$$

3.2.4. Bandwidth Utilization

The bandwidth utilization is calculated based on user need, content transmission size & system efficiency. The bandwidth ensure the how techniques effective to avoid traffic and congestion issues with minimal physical resource utilization. The Bandwidth Utilization is calculated in equation (4).

$$BW_{utlization} = \frac{BW_{Assigned}}{Npr} \tag{4}$$

Where, $BW_{Assigned}$ is bandwidth allocation of peer in network for data transmissions. Npr indicates the total number of peer request for effective data transmissions in networks.

Table 1 explains the Packet Lose Rate (PLR), Average Delay (AD), Throughput (T) and Bandwidth Utilizations (BU) for respective input parameters with existing methods. Table 1 displays the average value

on all respective evaluation matrix & input parameters with Multi-path Routing and Bandwidth Allocation (IMRBA) [21], Joint Routing, Scheduling and Admission control Protocol (JRSAP) [21] and Load-Dependent (LD) [22] existing methods. According to Table1, it noticed that proposed Efficient Bandwidth Utilization based Scheduling (EBS) algorithm performs well on all evaluation matrix and Input parameters compare than existing methods.

Table 1. PLR (Packet Lose Rate), AD (Average Delay), Throughput (T) and
BU (Bandwidth Utilizations) for 4, 6, 8, 10 peers

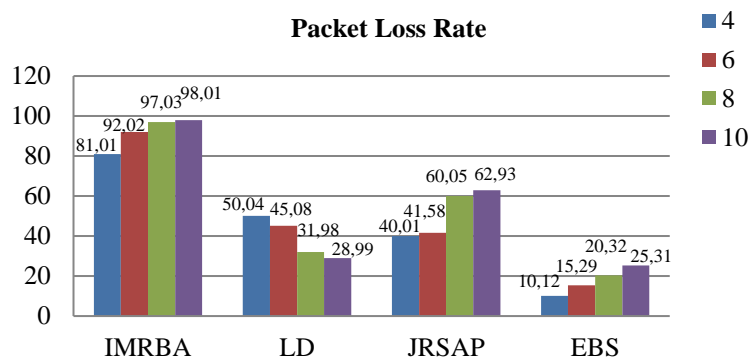| Techniques	4				6				8				10			
	PLR	AD	T	BU	PLR	AD	T	BU	PLR	AD	T	BU	PLR	AD	T	BU
IMRBA	81.01	28.03	10.99	37.99	92.02	32.45	14.91	38.88	97.03	38.05	18.65	39.78	98.01	40.05	26.99	40.65
LD	50.04	30.99	16.89	41.35	45.08	24.85	17.99	32.08	31.98	19.98	18.98	27.45	28.99	14.78	19.89	19.99
JRSAP	40.01	17.56	20.99	47.99	41.58	19.26	27.89	48.89	60.05	20.99	30.79	49.78	62.93	22.65	38.95	60.03
EBS	10.12	12.27	95.12	22.21	15.29	14.79	89.62	24.29	20.32	18.27	75.13	25.55	25.31	22.11	65.23	18.22

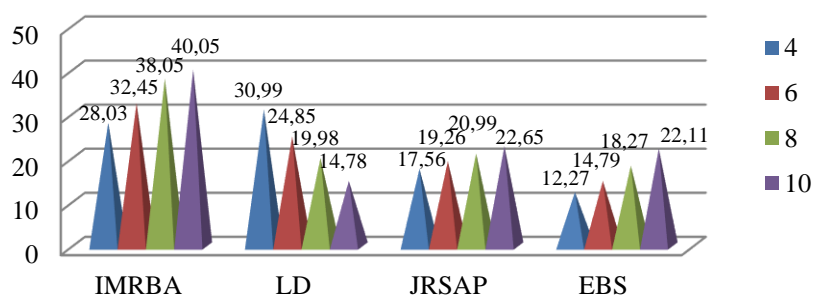Figure 4. Packet Loss Rate for 4, 6, 8, 10 peers

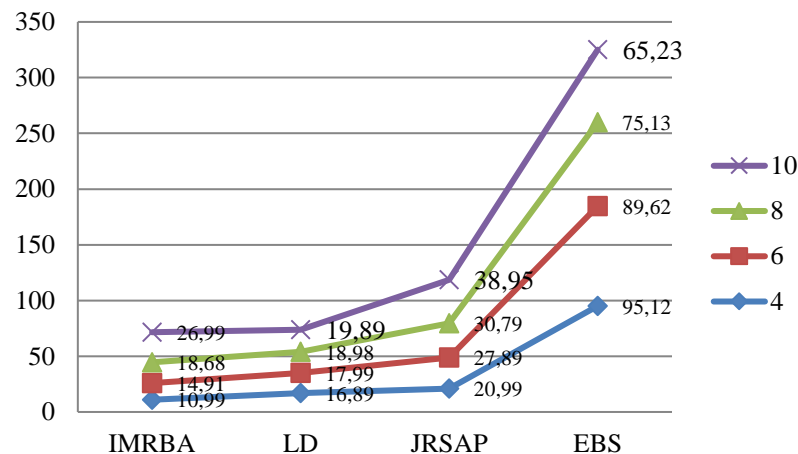

Figure 5. Average Delay for 4, 6, 8, 10 peers
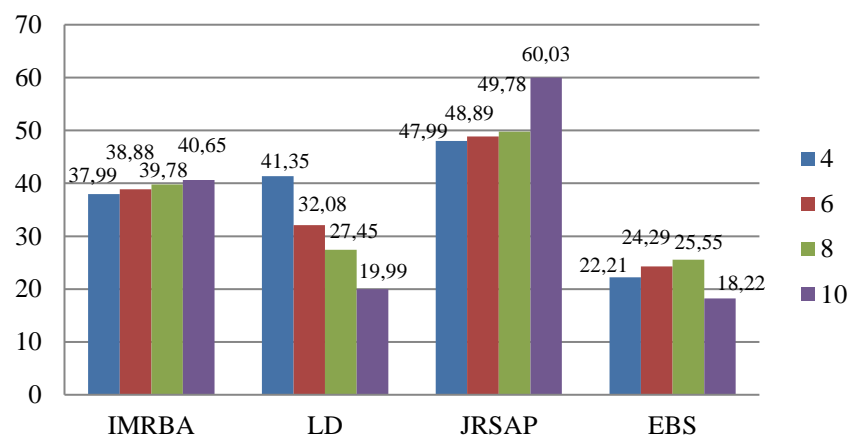
Figure 6. Throughput for 4, 6, 8, 10 peers

Figure 7. Bandwidth Utilization for 4, 6, 8, 10 peers

According to Figure 4 to 7 observations for 4, 6, 8, 10, the proposed techniques evaluates packet loss rate, average delay, throughput and bandwidth utilization for finding the efficiency. Proposed EBS is evaluated with IMRBA [21], JRSAP [21] and LD [22] existing techniques behalf of packet loss rate, average delay, throughput and bandwidth utilization. In terms of PLR &BU, proposed technique closest competitor is LD [22] on overall parameters. LD techniques improved homogeneous Poisson packet arrival for dynamic bandwidth allocation. It improved the performance of various commercials application for data transmissions. However, LD technique failed to consider bandwidth re-utilization & packet delay. Behalf of AD & Throughput, JRSAP is the closest techniques. JRSAP enhanced the packets broadcasting as per selected slots from the dissimilar priority of traffic classes adaptively, depending on the channel state. However, it fails to maintain same QoS guaranteed services for unutilized bandwidth, and the execution is complicated for unutilized bandwidth. EBS improves the bandwidth utilization during maintenance of the same QoS guaranteed services. It also avoids the current bandwidth reservation collapse at the time of the same QoS guaranteed services. Proposed method improves the bandwidth re-utilization of un-utilized bandwidth. Proposed EBS reduces 21.26 PLR (Packet Loses Ratio), 3.25 AD (Average Delay), and improves 8.65 BU (Bandwidth Utilization) and 51.2% (Throughput) .Finally, the paper claims the proposed EBS methodology performs best on every evaluation matrix & respective input parameters

4. CONCLUSION

The paper presents an Efficient Bandwidth Utilization based Scheduling Algorithm to reutilize the un-utilized bandwidth on same guarantee quality of services. The main concept of proposed design is to permits other complementary station (CS). SSs are utilizing the un-utilized bandwidth left by the current transmitting SS. The un-utilized bandwidth is not supposed to occur regularly delay. The proposed method is real time applications, which have more flexibility to avoid delay & utilize the un-utilized bandwidth. The method predicts the volume of bandwidth to be requested based on the information of the backlogged amount of traffic in the queue and the rate mismatch between packet arrival & service rate to enhance the bandwidth utilization. The destination peer accepts the RREQ and receives the transmitted file from source peer. Hence, the data is splited into some packets based on the size. The shortest path is calculated in unutilized bandwidth and packets are received by subscriber station. EBS improves the bandwidth utilization during maintenance of the same QoS guaranteed services. It also avoids the current bandwidth reservation collapse at the time of the same QoS guaranteed services. Proposed method improves the bandwidth re-utilization of un-utilized bandwidth. Proposed EBS reduces 21.26 PLR (Packet Loses Ratio), 3.25 AD (Average Delay), and improves 8.65 BU (Bandwidth Utilization) and 51.2% (Throughput).Finally, the paper claims the proposed EBS methodology performs best on every evaluation matrix & respective input parameters.

In future work, the paper can be extended to offer content security with optimized route cost in Ad-hoc Network where, it very difficult to maintain data transmission reliability. The work plan is to improve the bandwidth consumption in Un-reliable networks.

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